ASTR-ASTRONOMY

ASTR 1115G. Introduction Astro (lec+lab)
4 Credits (3+2P)
This course surveys observations, theories, and methods of modern astronomy. The course is predominantly for non-science majors, aiming to provide a conceptual understanding of the universe and the basic physics that governs it. Due to the broad coverage of this course, the specific topics and concepts treated may vary. Commonly presented subjects include the general movements of the sky and history of astronomy, followed by an introduction to basic physics concepts like Newton's and Kepler's laws of motion. The course may also provide modern details and facts about celestial bodies in our solar system, as well as differentiation between them – Terrestrial and Jovian planets, exoplanets, the practical meaning of “dwarf planets”, asteroids, comets, and Kuiper Belt and Trans-Neptunian Objects. Beyond this we may study stars and galaxies, star clusters, nebulae, black holes, and clusters of galaxies. Finally, we may study cosmology—the structure and history of the universe. The lab component of this course includes hands-on exercises that work to reinforce concepts covered in the lecture, and may include additional components that introduce students to the night sky.

Learning Outcomes
1. Students will discuss the night sky as seen from Earth, including coordinate systems, the apparent daily and yearly motions of the sun, Moon, and stars, and their resulting astronomical phenomena.
2. Students will list and apply the steps of the scientific method.
3. Students will describe the scale of the Solar System, Galaxy, and the Universe.
4. Students will explain telescope design and how telescopes and spectra are used to extract information about astronomical objects.
5. Students will describe the formation scenarios and properties of solar system objects.
6. Students will describe gravity, electromagnetism, and other physical processes that determine the appearance of the universe and its constituents.
7. Students will describe methods by which planets are discovered around other stars and current results.
8. Students will describe the structure, energy generation, and activity of the sun.
9. Students will compare our sun to other stars and outline the evolution of stars of different masses and its end products, including black holes.
10. Students will describe the structure of the Milky Way and other galaxies and galaxy clusters.
11. Students will describe the origin, evolution, and expansion of the universe based on the Big Bang Theory and recent Astronomical observations.
12. Students will describe conditions for life, its origins, and possible locations in the universe.

ASTR 1116. Introduction to Astronomy Lab, Special
1 Credit (1)
This lab-only listing exists only for students who may have transferred to NMSU having taken a lecture-only introductory astronomy class, to allow them to complete the lab requirement to fulfill the general education requirement. Consent of Instructor required. Restricted to Las Cruces campus only.

Prerequisite(s): Must have passed Introduction to Astronomy lecture-only.

Learning Outcomes
1. Course is used to complete lab portion only of ASTR 1115G or ASTR 112
2. Learning outcomes are the same as those for the lab portion of the respective course.

ASTR 1120G. The Planets
4 Credits (3+2P)
Comparative study of the planets, moons, comets, and asteroids which comprise the solar system. Emphasis on geological and physical processes which shape the surfaces and atmospheres of the planets. Laboratory exercises include analysis of images returned by spacecraft. Intended for non-science majors, but some basic math required.

Learning Outcomes
1. Students will describe the sky as seen from Earth, the apparent daily and yearly motions of the Sun, Moon, planets and stars, and resulting astronomical phenomena.
2. Students will apply the process of the scientific method in an astrophysical setting.
3. Students will describe the structure of the solar system and explain the development of the currently accepted model of solar system formation.
4. Students will explain how telescopes and spectra are used to extract information about astronomical objects.
5. Students will describe properties of minor solar system objects, such as dwarf planets, moons, asteroids, meteoroids, and comets.
6. Students will compare and contrast bulk and unique properties of the Terrestrial and Jovian worlds.
7. Students will describe how gravity and other physical processes determine the appearance of the solar system and its constituents.

ASTR 301V. Revolutionary Ideas in Astronomy
3 Credits (3)
Examines recent fundamental scientific revolutions that have shaped our view of Earth and the universe. Topics in astronomy range from exoplanets to black holes to dark energy and raise questions about the very nature of how we use the scientific method to see the unseen, and how this shapes science research today.

Prerequisite(s): Any general education science course.

ASTR 305V. The Search for Life in the Universe
3 Credits (3)
Use of information from several of the sciences to explore the likelihood that life exists elsewhere in the universe. Subjects include an overview of historical ideas about the possibility of life elsewhere in the universe, the chemistry and biology of life on Earth, recent explorations for life within our solar system, and current search strategies for life in the universe and their scientific basis.
ASTR 308V. Into the Final Frontier
3 Credits (3)
Exploration of space: a brief review of the history of space flight, the Apollo program, joint U.S.-Soviet space missions, and unstaffed exploration of the planets. Emphasis on knowledge gained through these efforts. Includes new space initiatives. Same as HNRS 308V.

ASTR 400. Undergraduate Research
1-3 Credits
Supervised individual study or research. May be repeated for a maximum of 6 credits.
Prerequisite: consent of instructor.

ASTR 401. Topics in Modern Astrophysics
3 Credits (3)
This course is designed for students interested in astrophysics who have some background in math and physics and want to learn about basic astrophysics and interesting current topics. The course will cover basic astrophysical concepts such as orbital mechanics, light, and radiative processes and transfer. These concepts will be applied to the discussion of exciting modern topics involving planets, exoplanets, stars, galaxies, and/or cosmology, with topical emphasis determined by the instructor.
Prerequisite(s): MATH 1521G and (PHYS 2110 or PHYS 1310G).

ASTR 402. Introduction to Astronomical Observations and Techniques
3 Credits (3)
Designed for students interested in astrophysics who have some background in math and astronomy and want to learn about techniques for obtaining and analyzing astronomical data. This course will review the properties of light and discuss the process of experimental design. The course will describe basic observational tools such as telescopes and detectors. It will discuss how data is obtained, and how features of the detector and the Earth’s atmosphere can be corrected for. Some topics in basic astronomical data analysis will be discussed, with topical emphasis determined by the instructor. Some simple data analysis projects will be assigned.
Prerequisite(s): MATH 1511G and (PHYS 2140 or PHYS 1320G) and (ASTR 1120G, ASTR 1115G, or ASTR 401).

ASTR 403. Fundamentals of Astronomy
3 Credits (3)
This course is designed to ensure a basic, quantitative knowledge of fundamental topics in astronomy and astrophysics. These topics include orbital mechanics, properties of radiation, principles of stellar radiation and spectra, structure and dynamics of the Milky Way, properties of galaxies, and basic cosmology. While this course is designed for first year graduate students, it is also cross-listed as a undergraduate course for students who have already had some exposure to astronomy and are prepared for a fast-paced review of fundamental topics and concepts in astronomy. Undergraduates will have a reduced homework load. Consent of Instructor required. Crosslisted with: ASTR 505.
Prerequisite(s): ASTR 401 or demonstrated background in astronomy and problem solving.

ASTR 500. Seminar
1 Credit (1)
Organized group study treating selected topics.

ASTR 503. Astrophysics
3 Credits (3)
This course is designed to ensure a basic, quantitative knowledge of fundamental topics in astronomy and astrophysics. These topics include orbital mechanics, properties of radiation, principles of stellar radiation and spectra, structure and dynamics of the Milky Way, properties of galaxies, and basic cosmology.

ASTR 506. Stellar Dynamics and Hydrodynamics
3 Credits (3)
Graduate level course on basic stellar dynamics and fundamentals of hydrodynamics.

ASTR 530. Gas and Radiative Processes in Stars, Galaxies and the IGM
3 Credits (3)
This course will introduce the basic physics of the primary gaseous environments in the universe and their observational signatures. Astrophysical environment to be addressed will include the atmospheres of stars, the interstellar medium, the circumgalactic medium, and the intergalactic medium. Physical processes covered will include gas hydrodynamics, radiative and collisional excitation and ionization balance in astrophysics, atomic processes and detailed balancing, heating and cooling balance, and evolution. From the observational point of view, the course will discuss the spectral signatures of these processes, including stellar spectra, 21-cm spectra, emission line spectra from HII regions and planetary nebulae, and absorption lines from the interstellar medium, circumgalactic medium, and intergalactic medium.

ASTR 535. Observational Techniques I (f)
3 Credits (3)
Up-to-date introduction to modern observational astronomy in a two-semester sequence. Topics include: introduction to computers, error analysis in data, the different types of optical telescopes, and optical and infrared photometry, image processing, and detectors.

ASTR 545. Stellar Spectroscopy
3 Credits (3)
This course covers the physics of stellar atmospheres with emphasis on using spectra as a diagnostic tool for understanding the properties of stars. Topics include spectral classification, radiative transfer, gas equilibrium physics, line and continuum opacities, adiabatic and superadiabatic convection, and extraction of observed quantities from spectra for deducing physical conditions of the source.

ASTR 555. Galaxies I
3 Credits (3)
Fundamentals of the properties of galaxies and galaxy components, including stars and stellar populations, gas and dust, central black holes, and dark matter. Includes a detailed description of the properties of the Milky Way Galaxy.

ASTR 565. Stellar Interiors
3 Credits (3)
Internal constitutions of stars, computation of stellar models, and stellar evolution.

ASTR 598. Special Research Programs
1-6 Credits
Individual investigations, either analytical or experimental.

ASTR 599. Master's Thesis
15 Credits
Master's level research in astrophysics or observational astronomy.

ASTR 600. Pre-dissertation Research
1-15 Credits
Research.

ASTR 605. Interstellar Medium
3 Credits (3)
Basics of radiative transfer and processes in the interstellar medium. Properties of dust and infrared emission from grains. Applications to neutral atomic and molecular gas and ionized plasmas in galaxies. May be repeated up to 3 credits.
ASTR 610. Radio Astronomy  
3 Credits (3)  
Techniques in observational radio astronomy, including single dish and interferometer arrays. Physical processes that produce radio emission, with a focus on continuum emission. May be repeated up to 3 credits.  
Prerequisite(s): Consent of instructor.

ASTR 616. Galaxies II  
3 Credits (3)  
Galaxy formation within a cosmological context. Topics include an introduction to cosmology, the growth of linear and nonlinear structures, the formation of dark matter halos, galaxy growth and feedback processes, and their observational signatures in the intergalactic and circumgalactic media.

ASTR 620. Planetary Surface and Atmospheric Processes  
3 Credits (3)  
Evaluation and analysis of observational data on solar system objects to determine their nature and physical conditions, with emphasis upon atmospheres (composition, structure, thermodynamics, evolution, etc.) May be repeated up to 3 credits. Restricted to: ASTR majors.

ASTR 621. Planetary System Formation  
3 Credits (3)  
The physical processes involved in planetary system formation are addressed. Specific foci include molecular cloud collapse, disk processes, and competing theories of planet formation within disks. Additional topics to be discussed may include: the solar wind, planetary magnetic fields, planetary ring processes, and mineralogy. May be repeated up to 3 credits. Restricted to: ASTR majors.

ASTR 625. Cosmology  
3 Credits (3)  
Discussion of our current knowledge of the structure of the universe and current research methods. Topics include the distance scale, clustering of galaxies, large-scale structure, metrics, dark matter, and cosmological probes such as distant quasars, radio galaxies, and gravitational lenses.

ASTR 630. Numerical and Statistical Methods in Astrophysics  
3 Credits (3)  
Provides basic background in numerical and statistical methods relevant to astrophysical research. Topics include a review of probability and probability distribution functions, Bayesian and frequentist approaches, data simulation, parameter estimation, Markov Chain Monte Carlo, and other topics. May be repeated up to 3 credits.

ASTR 670. Heliophysics  
3 Credits (3)  
Explore the Sun and its processes, the heliopshere, and its interactions with the planets. Topics include: A introductory description of space weather and its physics; energy interaction with the space environment; the quiet Sun and its interactions with planetary atmospheres (with an emphasis on Earth); Magnetohydrodynamics; frozen-in flux; the solar wind; magnetized fluid dynamics; the active Sun(flares and coronal mass ejections); the effects of Space Weather.

ASTR 698. Special Topics.  
1-9 Credits  
Special topics.

ASTR 700. Doctoral Dissertation  
15 Credits  
Dissertation.